Amendments to the Claims

This listing of claims will replace all prior versions and listings of claims in the application:

Listing of Claims

Claims 1-6 (Canceled)

7. (Previously presented) A method of reducing unwanted acoustical feedback in a space having at least one microphone for transducing acoustic signals into electrical input signals and at least one speaker for transducing electrical output signals into acoustic signals, the method comprising:

converting electrical input signals to corresponding digital input signals;

examining the digital input signals for at least one candidate signal of unwanted acoustical feedback;

adjusting at least one digital filter in response to a detection of the at least one candidate signal of unwanted acoustical feedback;

processing the digital input signals through the at least one digital filter to generate digital output signals;

converting the digital output signals to electrical output signals;

testing the electrical output signals by broadcasting the electrical output signals through the at least one speaker to generate new input signals and analyzing the effect of processing the digital input signals; and

readjusting the at least one digital filter by decreasing a depth of the at least one digital filter if a magnitude of the at least one candidate signal of unwanted acoustical feedback is not reduced by a predetermined amount, such that the unwanted acoustical feedback in the space is reduced.

8. (Previously presented) The method of claim 7 wherein the readjusting step further comprises increasing the depth of the at least one digital filter if a magnitude of the at least one candidate signal of unwanted acoustical feedback is reduced by a predetermined amount.

9. (Previously presented) The method of claim 7 wherein the converting electrical input signals step also comprises:

transforming the digital input signals into a frequency spectrum to produce a plurality of bin values wherein each bin value represents a function of an amplitude of the digital input signals across a frequency spectrum bandwidth.

10. (Previously presented) The method of claim 9 wherein the function is a sum of a square of a real component of the amplitude of the digital input signals and a square of an imaginary component of the amplitude of the digital input signals.

11. (Previously presented) The method of claim 9 wherein the function is a square root of a sum of a square of a real component of the amplitude of the digital input signals plus a square of an imaginary component of the amplitude of the digital input signals.

12. (Previously presented) The method of claim 7 wherein the examining step further comprises:

establishing a set of candidates comprising a predetermined number of bin values with largest magnitudes,

testing each candidate in the set of candidates by determining an acoustical significance of each candidate and removing the respective candidate from the set of candidates if the respective candidate is not acoustically significant, and

determining the at least one candidate signal of unwanted acoustical feedback from the set of candidates.

13. (Previously presented) The method of claim 12 wherein determining the acoustical significance comprises:

determining an average value which is a function of the magnitudes of the predetermined number of bin values;

comparing the bin value of each candidate in the set of candidates to an absolute value and removing the respective candidate from the set of candidates if the respective bin value of the respective candidate is less than the absolute value; and

comparing the bin value of each candidate to a relative value, and removing the respective candidate from the set of candidates if the bin value of the respective candidate is less

than the relative value, wherein the relative value is a function of the average value and a relative multiplier.

14. (Previously presented) The method of claim 13 wherein the relative multiplier is a function of the magnitudes of the predetermined number of bin values.

15. (Currently amended) The method of claim 12 wherein the magnitudes are calculated by a process which includes:

transforming the digital input signals into a frequency spectrum to generate a plurality of new bin values wherein each new bin value represents the function of an amplitude of the digital input signals across the frequency spectrum bandwidth,

comparing the new bin value [[to]] to at least one of the predetermined number of bin values,

setting at least one of the predetermined number of bin values to the new bin value when the new bin value is less than the at least one of the predetermined number of bin values, and

setting the at least one of the predetermined number of bin values to a filtered value when the new bin value is greater than the at least one of the predetermined number of bin values.

16. (Previously presented) The method of claim 15 wherein the filtered value is calculated by:

Filtered Value = (new bin value -bin value)*K + bin value

Where K is a filtering coefficient.

17. (Previously presented) The method of claim 16 wherein the filtering coefficient (K) is calculated by:

K = 1 - (1 - Threshold) ^ (1/(t*Ffs))

Where t is a required response time, the Threshold is a fractional value of a target magnitude for which a time value is calibrated, and Ffs relates to an interval rate.

18. (Previously presented) The method of claim 17 wherein the time value varies according to a frequency relating to the respective bin value.

19. (Previously presented) A method of reducing unwanted acoustical feedback in a plurality of sound signals, the method comprising:

sampling the plurality of sound signals at predetermined intervals to create a set of sampled sound signals;

transforming a sound signal from the set of sampled sound signals, to a frequency spectrum comprising a plurality of frequency bins, each bin having a new bin value which is a function of a magnitude of a frequency of the sound signal over a predetermined frequency width;

comparing each new bin value to a bin value;

setting the bin value to a new bin value when the new bin value is less than the bin value;

setting the bin value to a filtered value when the new bin value is greater than the stored bin value;

selecting a set of candidate frequencies from the bin value having the largest values;

testing an acoustic significance of each candidate frequency in the set of candidate frequencies and removing a respective candidate frequency from the set of candidate frequencies if the respective candidate is not acoustically significant, such that at least one candidate feedback frequency is determined;

adjusting at least one notch filter to filter the at least one candidate feedback frequency;

processing the plurality of sound signals through the at least one notch filter; and

readjusting the at least one notch filter to filter for the at least one candidate feedback frequency wherein the at least one notch filter's depth is decreased if the at least one candidate feedback frequency has not been reduced by a predetermined amount, such that unwanted acoustical feedback is reduced.

20. (Previously presented) The method of claim 19 wherein the readjusting step further comprises increasing the at least one notch filter's depth if the at least one candidate feedback frequency has been reduced by a predetermined amount.

21. (Previously presented) The method of claim 19 wherein the testing an acoustical significance of each candidate frequency comprises:

determining an average value which is a function of an average of the plurality of bin values;

comparing the bin value of each candidate frequency in the set of candidate frequencies to an absolute value and removing the respective candidate frequency from the set of candidate frequencies if a respective bin value of the respective candidate frequency is less than the absolute value; and

comparing the respective bin value of each candidate frequency to a relative value, and

removing the respective candidate frequency from the set of candidate frequencies if the respective bin value of the respective candidate frequency is less than the relative value, wherein the relative value is a function of the average value and a relative multiplier.

22. (Previously presented) The method of claim 21 wherein the relative multiplier is a function of the magnitudes of the plurality of frequency bin values.

23. (Previously presented) The method of claim 19 wherein the filtered value is calculated by:

Filtered Value = (new bin value - bin value)*K + bin value, where K is a filtering coefficient.

24. (Previously presented) The method of claim 23 wherein the filtering coefficient (K) is calculated by: K = 1 - (1 - Threshold) ^ (1/(t*Ffs))

Where t is a required response time, the Threshold is a fractional value of a target magnitude for which a time value is calibrated, and Ffs relates to an interval rate.

25. (Previously presented) The method of claim 24 wherein the time value varies according to a frequency relating to the respective bin value.

26. (Currently amended) A system for reducing unwanted acoustical feedback comprising:

at least one processor;

at least one memory accessible to the at least one processor; and

programming comprising instructions for:

examining a plurality of digital input signals for at least one candidate signal of unwanted acoustical feedback;

adjusting at least one digital filter in response to a detection of the at least one candidate signal;

processing the digital input signals through the at least one digital filter to generate digital output signals;

converting the digital output signals to audio output signals;

testing the audio output signals by broadcasting the audio output signals through a speaker to generate new audio input signals and analyzing the effect of processing the digital input signals; and

readjusting the at least one digital filter by decreasing [[the]] a depth of the at least one digital filter if [[the]] a magnitude of the at least one candidate signal is not reduced by a predetermined amount, such that the unwanted acoustical feedback in the space is reduced.

27. (Previously presented) The system of claim 26 wherein the readjusting instructions further comprise increasing the depth of the at least one digital filter if the at least one candidate signal has been reduced by a predetermined amount.

28. (Previously presented) The system of claim 26 wherein the programming further includes instructions for:

transforming the digital input signals into a frequency spectrum at an interval rate to produce a plurality of bin values wherein each bin value represents a function of an amplitude of the digital input signals across a frequency spectrum bandwidth.

29. (Previously presented) The system of claim 28 wherein the function is a sum of a square of a real component of the amplitude and a square of an imaginary component of the amplitude.

30. (Previously presented) The system of claim 28 wherein the function is a square root of a sum of a square of a real component of the amplitude and a square of an imaginary component of the amplitude.

Claims 31 – 37 (Canceled)

38. (Currently amended) An apparatus for reducing unwanted acoustical feedback in a space having at least one microphone for transducing acoustic signals into electrical input signals and at least one speaker for transducing electrical output signals into acoustic signals, the apparatus comprising:

an analog-to-digital converter which converts the electrical input signals to digital input signals;

at least one processor coupled to the analog-to-digital converter;

a memory accessible to the at least one processor for storing software modules, including an examining module to examine the digital input signals for candidate feedback frequencies,

at least one digital notch filter implemented in the at least one processor which processes the digital input signals and wherein the at least one processor determines parameters for the at least one digital notch filter in response to a detection of at least one candidate frequency in at least one of the digital input signals,

a digital to analog converter coupled to the at least one processor configured to convert the digital output signals to electrical output signals,

a testing module which decreases [[the]] <u>a</u> notch depth parameter if a magnitude of the at least one candidate frequency is not reduced by a predetermined amount,

<u>instructions which transform the digital input signals into a frequency spectrum to produce a plurality of bin values in the memory wherein each of the bin values is a function of an amplitude of a frequency spectrum for each of the bin values;</u>

a module for determining a set of candidates representing a respective set of largest values;

a candidate testing module which tests each candidate in the set of candidates to determine the acoustical significance of each candidate;

a calculating module for repeating instructions in the testing module to generate a plurality of new bin values, comparing a new bin value to the bin value, setting the bin value to the new bin value when the new bin value is less than the bin value, and setting the bin value to a filtered value when the new bin value is greater than the old bin value, where the filtered value is calculated by:

Filtered Value = (New Bin Value – Bin Value)*K + Bin Value

Where K is a filtering coefficient.

39. (Previously presented) The apparatus of claim 38 wherein the testing module examines audio output signals and increases a notch depth parameter for the at least one digital notch filter if a magnitude of the at least one candidate frequency is reduced by a predetermined amount.

40. (canceled).

41. (Currently amended) The apparatus of claim [[40]] 38 wherein the function is a sum of a square of a real component of the amplitude and a square of an imaginary component of the amplitude.

42. (Currently amended) The apparatus of claim [[40]] 38 wherein the function is a square root of a sum of a square of a real component of the amplitude and a square of an imaginary component of the amplitude.

43. (canceled).

44. (Currently amended) The apparatus of claim [[43]] 38 wherein the parameters for the at least one digital filter are determined from the set of candidates.

45. (Currently amended) The apparatus of claim [[43]] 38 wherein the candidate testing module includes:

an averaging module which reads the value of each bin and calculates an average for the plurality of bins.

a comparing module which compares each candidate in the set of candidates to a predetermined value, and eliminates the candidate from the set of candidates if the candidate is less than the predetermined value, and compares each candidate to a relative value, and eliminates the candidate from the set of candidates if the candidate is less than the relative value, wherein the relative value is a function of the average and a relative multiplier.

46. (Previously presented) The apparatus of claim 45 wherein the relative multiplier is a function of the magnitudes of the plurality of bins.

47. (canceled).

48. (canceled)

49. (Currently amended) The apparatus of claim [[48]] 38 wherein the filtering coefficient (K) is calculated by:

K = 1 - (1 - Threshold) ^ (1/(t*Ffs))

Where t is a required response time, the Threshold is the fractional value of a target magnitude for which the time value is calibrated, and Ffs is the frame sample rate.

50. (Previously presented) The apparatus of claim 49 wherein the time varies according to the frequency value of a frequency bin under consideration.